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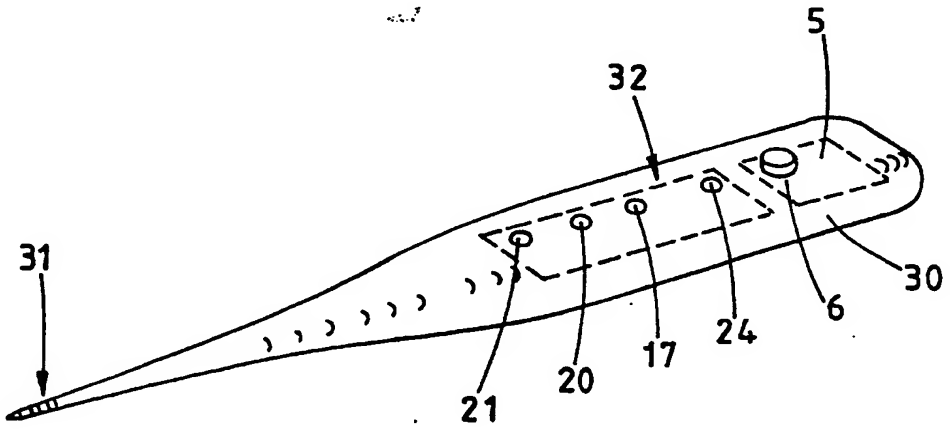

(57) Abstract

A food thermometer comprises an enclosure (30) with a temperature sensitive transducer located in its tip (31). Light emitting diodes (17, 20, 21) are controlled by a control circuit (32) powered by the battery (30) via a switch (6). The control circuit (32) compares the output of the transducer with preset values and illuminates each of the light emitting diodes when a corresponding preset value is exceeded.

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FOOD THERMOMETER

The present invention relates to a food thermometer.

In order to kill germs which cause food poisoning, it is necessary to heat food to various predetermined minimum temperatures which depend upon whether the food is raw prior to cooking or is being re-heated after previous cooking. In order to prevent food poisoning, it is also important that frozen foods be allowed to thaw to a predetermined minimum temperature prior to cooking.

With increasing use of frozen and precooked foods, it is becoming increasingly important in a domestic environment for the various minimum temperatures to be determined reliably. Although conventional thermometers of the Mercury-in-glass type are available covering the range of temperatures necessary for the preparation and cooking of food, such thermometers are fragile, difficult to read and require detailed knowledge of the various minimum temperatures. Although electronic thermometers do exist, they are generally laboratory tools and are unsuitable for use in a domestic kitchen. For instance, detailed knowledge of the minimum temperatures is still necessary and the constructions of such thermometers do not permit efficient and hygienic cleaning, for instance as part of the "washing-up" after preparation of food.

According to the invention, there is provided a food thermometer comprising an enclosure having an elongate portion with a tip, a temperature sensitive transducer located at the tip, at least one visual indicator located within and visible through the enclosure, a battery located within the enclosure, and a control circuit

located within the enclosure and a responsive to the located within the enclosure and responsive to the transducer for actuating the or each indicator when the temperature of the transducer exceeds a predetermined value, the enclosure being sealed to prevent ingress of liquid.

Preferably there are a plurality of visual indicators and the control circuit is arranged to actuate each indicator when the temperature of the transducer exceeds a respective preset value.

It is thus possible to provide an electronic thermometer which gives a clear and unambiguous indication of when one or more predetermined temperatures has been reached and which can readily be cleaned hygienically without the need for special measures. Such a thermometer can be used easily and reliably by untrained personnel, such as a cook in a domestic kitchen, and allows various types of food to be prepared with little or no risk of biological contamination and food poisoning.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a circuit diagram of a food thermometer constituting a preferred embodiment of the invention; and

Figure 2 is an external view of the food thermometer of Figure 1.

A temperature-sensitive transducer 1 is connected to the inputs of a differential amplifier 2. The transducer 1 is shown as a thermo-couple in Figure 1 but other types

of transducer, such as thermistors and temperature sensitive semi-conductor devices, may alternatively be used. The differential amplifier 2 is directly coupled and is, for instance, based on an operational amplifier providing sufficient gain so that the output signal of the differential amplifier 2 is at a level suitable for subsequent processing.

The differential amplifier 2 is provided with positive and negative power supply inputs which are connected to a positive power supply line 3 and a negative power supply line 4. The negative supply line 4 is connected to the negative terminal of a battery 5 whereas the positive supply line 3 is connected to the positive terminal of the battery 5 via a normally open switch 6 of the "push to make/release to break" type.

The output of the differential amplifier 2 is connected to the non-inverting inputs of comparators 7, 8, and 9, which have power supply input terminals connected to the supply lines 3 and 4. The comparators 7, 8, and 9 may, for instance, be embodied as integrated circuit comparators or operational amplifiers. The comparators 7, 8 and 9 have inverting inputs which are connected to receive respective reference voltages from a reference voltage source. The reference voltage source comprises a zener diode 10 connected in series with a current limiting resistor 11 between the supply lines 3 and 4 with a potential divider comprising resistors 12 to 15 connected across the zener diode.

The output of the comparator 7 is connected via a current limiting resistor 16 and a light emitting diode 17 to the supply line 4. Similarly, the outputs of the comparators 8 and 9 are connected via current limiting resistors 18

and 19 and light emitting diodes 20 and 21 to the supply line. The light emitting diodes 17, 20 and 21 may be of any desired colour and may be of the same colour or of different colours.

Although Figure 1 illustrates a thermometer having three light emitting indicators, fewer indicators may be provided by omitting one or two of the comparators, light emitting diodes, and associated components. Alternatively, if a larger number of indicators is required, further comparators, light emitting diodes, and associated components may be provided. Each additional comparator has its non-inverting input connected to the output of the differential amplifier 2 and its inverting input connected to a further tap on the potential divider, for instance formed by including additional resistors in the potential divider.

A further comparator 22 has power supply inputs connected to the supply lines 3 and 4 and an output connected via a current limiting resistor 23 and a light emitting diode 24 to the supply line 4. The comparator 22 has a non-inverting input connected to a potential divider formed by resistors 25 and 26 connected in series between the supply lines 3 and 4. The comparator 22 has an inverting input connected to a potential divider formed by resistors 27 and 28 connected in series between the negative supply line 4 and the connection between the zener diode 10 and the resistor 11. The comparator 22 thus compares the battery voltage with a stable voltage derived from the zener diode and illuminates the light emitting diode 24 when the terminal voltage on load of the battery 5 is sufficient to ensure correct operation of the thermometer. However, when the on load terminal voltage falls below a predetermined adequate value, the

light emitting diode 24 is extinguished so as to give an indication that the battery 5 should be replaced or the thermometer should be discarded and replaced by a new thermometer.

As shown in Figure 2, the thermometer comprises an enclosure 30 of elongate shape having a tip 31 which is formed by or contains the temperature sensitive transducer 1. The locations of the battery 5, the light emitting diodes 17, 20, 21, and 24, the switch 6, and a circuit board 32 carrying the remainder of the components shown in Figure 1 are indicated in Figure 2. The light emitting diodes are located within the enclosure 30 below openings which are enclosed by transparent covers. The switch 6 is located below a flexible membrane sealed to the enclosure so as to permit actuation without exposing the switch itself. The enclosure 30 is therefore completely sealed against the ingress of foreign material, such as water and other liquids with which the thermometer may come into contact during use and during cleaning. The enclosure 30 is preferably formed of a heat resistant plastics material having a smooth outer surface to permit easy hygienic cleaning, for instance by conventional washing-up with other food preparation utensils.

In use, the switch 6 is actuated by external pressure on its membrane cover and the condition of the battery 5 is checked by observing whether the light emitting diode 24 is illuminated. If so, then the tip 31 is inserted into food at various points and left in place at each point for a few seconds to allow the transducer 1 to reach the local temperature of the food. The light emitting diodes 17, 20 and 21 are then checked for illumination so as to

indicate whether the appropriate temperature has been reached throughout the food.

For instance, in the case of testing previously frozen food to ascertain whether it has thawed sufficiently for cooking, the reference voltage supplied to the inverting input of the comparator 9 corresponds to a transducer temperature of 5°. The light emitting diode 21 will therefore be illuminated whenever a temperature greater than 5° is detected by the transducer 1. Similarly, the reference voltage supplied to the inverting input of the comparator 8 corresponds to 75° so that the light emitting diode 20 indicates whether pre-cooked food has reached its minimum temperature. The reference voltage supplied to the comparator 7 is set to a value such that the light emitting diode 17 illuminates when the transducer detects a temperature of 90° or greater for checking whether raw or uncooked food has reached its minimum cooking temperature.

With the thermometer shown in Figures 1 and 2, it is thus possible to provide reliable and easy indication of whether predetermined temperatures for safe preparation of food have been achieved while permitting the thermometer to be cleaned hygienically and without any special precautions in a domestic or kitchen environment. A food temperature of this type can readily be made insensitive to cleaning in dishwashers and the like and prevents the ingress of cleaning fluids (and also contact between food and the contents of the enclosure).

Thermometers of the type shown in Figures 1 and 2 may be used in other applications. For instance, the reference voltages could be chosen so that the light emitting diodes indicate whether the temperature of food is

substantially correct for a baby or infant, the light emitting diodes indicating whether the food temperature is too hot, correct, or too cold. The tip 31 may be formed as a blunted head to permit stirring of baby or infant food. The enclosure 30 may be designed to have the appearance of a utensil such as a spoon for use by a baby or infant in order to have an educational and aesthetically attractive function for use by a baby or infant.

The reference voltages may be chosen so as to indicate the condition of cooked meat, for instance providing indications as to whether meat is rare, medium or well done. For this purpose, it is possible to provide a thermometer having more than three indicators so as to provide an indication that different kinds of meat have been correctly cooked for individual tastes.

CLAIMS

1. A food thermometer comprising an enclosure having an elongate portion with a tip, a temperature sensitive transducer located at the tip, at least one visual indicator located within and visible through the enclosure, a battery located within the enclosure, and a control circuit located within the enclosure and responsive to the transducer for actuating the at least one indicator when the temperature of the transducer exceeds a predetermined value, the enclosure being sealed to prevent the ingress of liquid.

2. A food thermometer as claimed in Claim 1, in which the enclosure contains a normally open switch actuable from outside the enclosure to connect the battery to the control circuit.

3. A food thermometer as claimed in Claim 1, in which the at least one visual indicator comprises a plurality of visual indicators and the control circuit is arranged to actuate each indicator when the temperature of the transducer exceeds a respective preset value.

4. A food thermometer as claimed in Claim 3, in which the control circuit comprises a plurality of comparators having first inputs for receiving a signal corresponding to the transducer output signal and second inputs connected to respective reference voltage sources.

5. A food thermometer as claimed in Claim 4, in which the reference voltage sources comprise a potential divider connected to a constant voltage source.

6. A food thermometer as claimed in Claim 3, in which the indicators comprise light emitting diodes.

7. A food thermometer as claimed in Claim 3, in which the plurality of indicators comprises three indicators and the respective preset values correspond to 5, 75, and 90°C.

8. A food thermometer as claimed in Claim 1, including means for providing an indication of the condition of the battery.

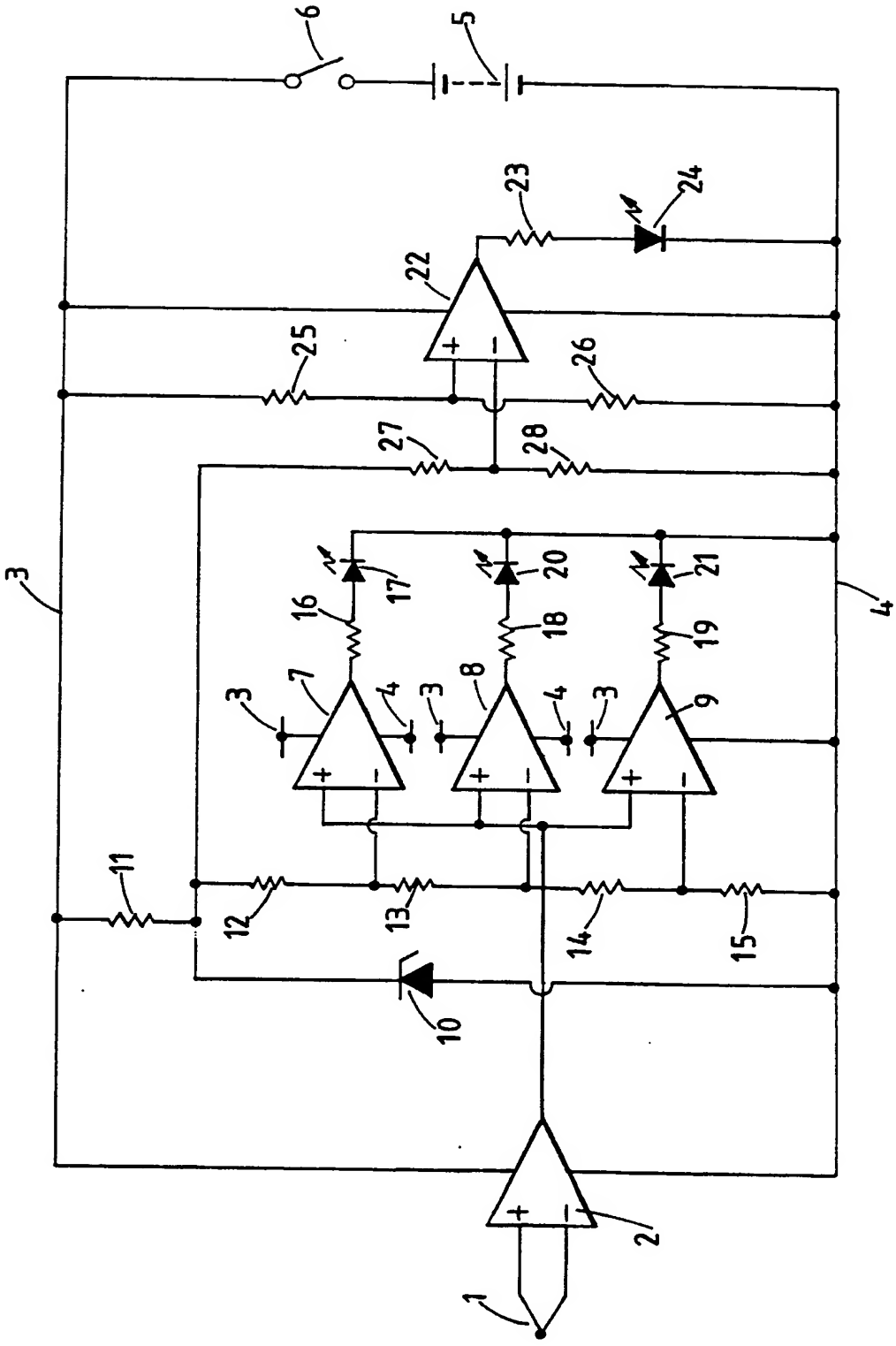

FIG. 1.

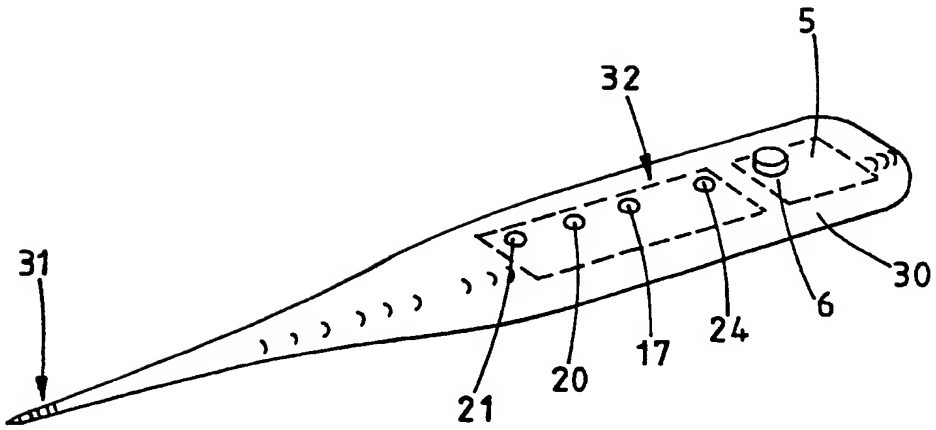

FIG. 2.

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/00452

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: G 01 K 13/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[5]	G 01 K 13, G 01 K 3

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	DE, U, 8013753 (KÄFERLEIN) 24 October 1985 see page 5 - page 6, paragraph 2; page 6, paragraphs 4-5; page 9, paragraph 2; figures	1
A	--	2,3,6
Y	DE, A, 2943977 (TOKYO SHIBAURA) 8 May 1980 see page 11, paragraph 2 - page 14; figures	1
A	--	4,5,7
A	DE, U, 8704350 (KUHNERT) 1 September 1988 see pages 3-5	1
	-- ./.	

* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
20th June 1990	13. 07. 90
International Searching Authority	**Signature of Authorized Officer**
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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	US, A, 3927571 (HOBART CORP.) 23 December 1975 see the whole document --	1,3-7
A	Patent Abstracts of Japan, vol. 9, no. 334 (P-417)(2057), 27 December 1985, & JP, A, 60158325 (MATSUSHITA DENKI SANGYO K.K.) 19 August 1985 --	4,5
A	FR, A, 2176051 (TIMM) 26 October 1973 see the whole document --	1,3
A	US, A, 3753259 (DONOVAN) 14 August 1973 see column 3, line 42 - column 9, line 23	1,3-5,8

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9000452 SA 35474

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 06/07/90
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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DE-A- 2943977	08-05-80	AU-B- 528778	12-05-83
		AU-A- 5230979	15-05-80
		CA-A- 1136225	23-11-82
		GB-A,B 2036378	25-06-80
		US-A- 4370535	25-01-83
DE-U- 8704350	21-07-88	None	
US-A- 3927571	23-12-75	None	
FR-A- 2176051	26-10-73	JP-A- 49014182	07-02-74
US-A- 3753259	14-08-73	None	